Climate Education: Visualizing Polar Ice Variability With Satellite Data

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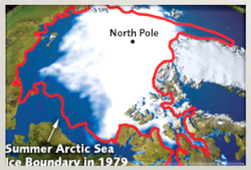
Background



Since 1979, the size of the summer polar ice cap has shrunk more than 20 percent.

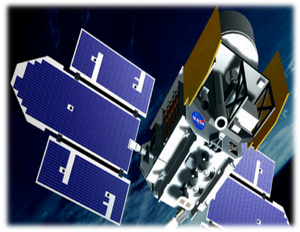
The world's climate is changing, and the changes have an enormous impact on our planet's people, ecosystems, cities, and energy use. Average global air temperatures are 1.5 degrees higher than they were at the start of the 20th century, and have risen about 1 degree over just the last 30 years.

One of the greatest impacts of climate change has been the melting of polar ice in the Arctic and Antarctic regions. As we now understand, due to the development of satellite technology, the amount of polar ice has an enormous impact on our global climate systems. Scientists are now divided as to the causes of the alarming rates of ice melt. While it has long been held that West Antarctic glaciers and sea ice are melting due to atmospheric global warming, scientists are also considering that geothermal heat from the West Antarctic rift (part of that area's tectonic plate system). This is warming the ocean water, which in turn is causing the ice sheet to melt faster than normal.

Remote Sensing Devices

Satellite data provides a tool for students to personally explore this continent, identify landscape features and processes, and look "beneath the glacier". Scientists use satellites to collect information about the Earth. Students participating in this unit learned about active and passive satellites.

- NASA launched the Ice, Cloud, and Land Elevation Satellite (ICESat) which used a laser to measure ice surface elevation from 2003 to 2009. These measurements are accurate to ~14 cm (6 inches) of elevation!
- In this study of polar ice variability, students used ICESat data to measure changes to the ice elevation of Pine Island Glacier.



Planning For An Interactive Polar Ice Study Including Differentiated Instruction

Immersion

Level I: Students participated in a field excursion to harvest snow and build their own glaciers. Sample glaciers were transported to the classroom to study the pattern of snow melt and glacial movement.

Level II: Students used the browser-based visualization technology, "Eyes on the Earth 3-D" which displays the location of all of NASA's 15 operating Earth-observing missions in real time. These missions constantly monitor our planet's vital signs, such as sea level height, global temperatures and extent of sea ice in the Arctic.

Level III: Students browsed through images and video of CReSIS field work exploring the use of radar technology and ice thickness.

Interactive Activities

Level I: Students applied science and math concepts while they joined virtual scientists in an interactive web based adventure to study subglacial lakes, thickness of the ice sheet, and sea level rise.

Level II: Students identified where the subglacial lakes are found in Antarctica which was the first step in understanding the role of these lakes in ice sheet movement. Students crafted digital maps created from visible and radar satellite imagery.

Level III: Students participated in an interactive lecture with NASA scientist Dr. Erica J. Alston in April 2015. Students asked about careers in science. The video of the lecture was shared with other classes.

Labs and Research

Level I: Students built glaciers out of Glacier Goo and measured its movement on graph paper. This data was then compared to the movement of satellite data for three real glaciers.

Level II: Students developed and tested hypothesis for the ice sheet behavior. Students compared their data to the real satellite glacier data that they gathered.

Level III: **Glacial Ice Sheet Physics:** Students conducted a series of experiments that explored basic physics concepts around glacier behavior. These labs included: **Glacier Physics, Basal Friction**, **Channel Friction, Drag, Gravity**, and **Force**.

Assessment

Level I: Assessments included vocabulary quizzes, notebook checks, participation, and a presentation on their research topic.

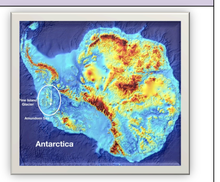
Level II: Students were assessed on their knowledge of satellite technology as evidenced by their data collection and analysis. They were asked to read an article and cite evidence from the text to support their position on climate change.

Level III: Students were assessed on lab reports, participation in class activities such as the video conference with a NASA scientist, and their presentation of their satellite data collection and analysis.

Study Focus Area

Pine Island Glacier

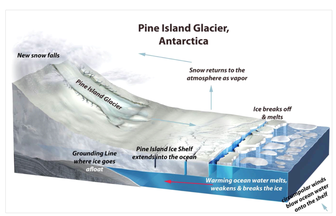
This map shows Antarctica without its ice sheet cover, surrounded by the deep blue ocean bottom. The continent colors represent elevation with the orange color indicating the highest elevation and the blue colors representing heights ranging from sea level to below sea level. Pine Island Glacier is circled showing the direction of ice flow.



Students used "Glacier Goo" to make a scale model of Pine Island Glacier and measured its movement down a model ramp to study the effect of gravity and friction on glacier movement.

Why Study Pine Island Glacier?

- It is traveling fast, moving at rates of 3.5 km/yr. – over 31 feet a day - currently pushing more ice into the oceans than any other Antarctic glacier.
- It is a relatively small area so the data sets will not be enormous for students to compare.



Student Engagement

Students braved the freezing temperatures to build model glaciers. Smaller samples were transported to the classroom to observe and to measure the patterns of ice melt.

Students made digital maps created from visible and radar satellite imagery using Mosaic of Antarctica (MOA) software.

Students prepare to make "Glacier Goo" model glaciers and measure their movement to compare to satellite data for actual glaciers.

Students compare satellite data.

Students participate in a virtual lecture with NASA scientist Dr. Erica J. Alston

Student Development

Students Worked Toward Mastery of Standards

In this unit on climate change, students used satellite data to study the amounts of polar ice variability and hypothesize causes of change.

This unit addressed the following Science Standards:

Physical Science 4C:	Information Technologies and Instrumentation
Earth and Space Science 1C:	The History of Planet Earth
Earth and Space Science 2B:	Plate Tectonics and Large-Scale Systems
Earth and Space Science 2D:	Weather and Climate
Earth and Space Science 3C:	Human Impacts on Earth Systems
Earth and Space Science 3D:	Global Climate Change

Students Participated in Distance Learning Lectures On Satellite Technology

Student Outcomes

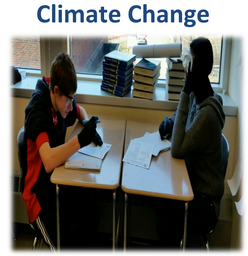
Students Used MY NASA DATA To Gather Authentic Data Sets

MY NASA DATA In The Classroom

There are 65 different languages spoken in the homes of our 1,800 students. My NASA DATA can be translated into 90 languages helping to accommodate our English Language Learners (ELLs).

Students in our Science classes are studying very different levels of Math, ranging from self-contained Special Education Math to Honors Pre-Calculus. MY NASA DATA allows for differentiation of instruction by providing over 200 data sets to accommodate every level.

Students Used Data to Define the Scope of Climate Change



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